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Novel capsaicin-induced parameters of microcirculation in migraine patients revealed by imaging photoplethysmography

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Abstract

Background: The non-invasive biomarkers of migraine can help to develop the personalized medication of this disorder. In testing of the antimigraine drugs the capsaicin-induced skin redness with activated TRPV1 receptors in sensory neurons associated with the release of the migraine mediator CGRP has already been widely used.

Methods: Fourteen migraine patients (mean age 34.6 ± 10.2 years) and 14 healthy volunteers (mean age 29.9 ± 9.7 years) participated in the experiment. A new arrangement of imaging photoplethysmography recently developed by us was used here to discover novel sensitive parameters of dermal blood flow during capsaicin applications in migraine patients.

Results: Blood pulsation amplitude (BPA) observed as optical-intensity waveform varying synchronously with heartbeat was used for detailed exploration of microcirculatory perfusion induced by capsicum patch application. The BPA signals, once having appeared after certain latent period, were progressively rising until being saturated. Capsaicin-induced high BPA areas were distributed unevenly under the patch, forming "hot spots." Interestingly the hot spots were much more variable in migraine patients than in the control group. In contrast to BPA, a slow component of waveforms related to the skin redness changed significantly less than BPA highlighting the latter parameter as the potential sensitive biomarker of capsaicin-induced activation of the blood flow. Thus, in migraine patients, there is a non-uniform (both in space and in time) reaction to capsaicin, resulting in highly variable openings of skin capillaries.

Conclusion: BPA dynamics measured by imaging photoplethysmography could serve as a novel sensitive non-invasive biomarker of migraine-associated changes in microcirculation.

Keywords: Migraine, Capsaicin, Microcirculation, CGRP, TRPV1, Dermal blood flow, Imaging photoplethysmography

Background

One of the main trends in migraine studies is to find out the most sensitive and preferably non-invasive biomarkers serving for the diagnostic and personalized treatments of this often-intractable disorder. Application of capsaicin to the skin is widely used to monitor the reactiveness of local blood flow following activation of capsaicin-sensitive TRPV1 receptors [1, 2]. The underlying mechanism of redness (flare) is mainly associated with the release of the neuropeptide CGRP from nociceptive C-fibers expressing TRPV1 receptors in membrane [3]. Several recent studies in animals and humans suggested the role of TRPV1 receptors in migraine [4, 5]. Accumulated evidence also suggested that CGRP is the main neuropeptide implicated in migraine pathology [6–8]. Many modern approaches for migraine treatment are based on inhibition of CGRP driven pro-nociceptive activity [7, 9]. This requires simple tests to evaluate the release of CGRP in humans. Thus, capsaicin-induced increase in dermal blood flow (DBF) is widely used to test the activity of potential anti-migraine medicines [2]. Apart from general

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